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PATENT
33379US1 (148341NM) (12553-1115)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Sunyu Su et al.

Art Unit: 3737

Serial No.: 10/085,347

Examiner: Eleni M. Mantis Mercader

Filed: February 27, 2002

For: UNEVEN-COUNTER-ROTATIONAL COIL BASED MRI RF COIL ARRAY

TRANSMITTAL LETTER ACCOMPANYING APPEAL BRIEF

Mail Stop: APPEAL BRIEF - PATENTS
Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Transmitted herewith is the Appeal Brief in this application. The Commissioner is authorized to charge the $500.00 fee for filing this Appeal Brief, pursuant to 37 CFR 41.20(b)(2), to Deposit Account 07-0845. *A duplicate copy of this transmittal letter is submitted for that purpose.*

The Notice of Appeal in this Application was mailed on ***July 28, 2006***. As indicated in the enclosed Certificate of Mailing by Express Mail, the Appeal Brief is being deposited with the U.S. Postal Service "Express Mail Post Office to Addressee" service (**Express Mail Label No. ED 399682915 US**), on ***October 30, 2006***.

Additionally, the Commissioner is hereby authorized to charge Deposit Account Number 07-0845 for a one-month extension in the amount of $120.00. The Commissioner is hereby also authorized to charge any additional fees or credit any overpayment to Deposit Account Number 07-0845. *A duplicate copy of this letter is enclosed.*

Respectfully submitted,

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- Transmittal Letter Accompanying Appeal Brief (1 pg., *in duplicate*)
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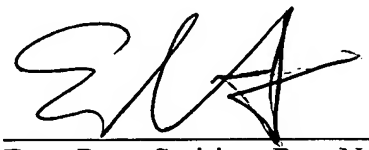
Respectfully submitted,



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APPELLANTS' BRIEF

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The Notice of Appeal in this Application was filed on July 28, 2006.

Table of Contents

This brief contains the following sections under the headings and in the order set forth below.

No Evidence Appendix and no Related Proceedings Appendix are part of this appeal brief.

I. REAL PARTY IN INTEREST

The real party in interest in this appeal is General Electric Company, 1 River Road, Schenectady, New York 12345.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences which will directly affect, or be directly affected by, or have a bearing on, the decision in this pending appeal.

III. STATUS OF CLAIMS

Presently, claims 1-20 are pending in the subject application and are on appeal. Claims 1-20 stand rejected.

IV. STATUS OF AMENDMENTS

A Notice of Appeal was filed on January 4, 2005 and a first Appeal Brief in support thereof was filed on May 4, 2005. A Final Office Action was mailed July 27, 2005 in response to the first Appeal Brief, which reopened prosecution to address all relevant claims and maintained the final rejection of all pending claims. Thereafter, a Notice of Appeal was filed on October 27, 2005 and a second Appeal Brief in support thereof was filed on December 27, 2005. An Office Action was mailed March 28, 2006 in response to the second Appeal Brief, which reopened prosecution to address all relevant claims and maintained the rejection of all pending claims with the same prior art reference.

V. SUMMARY OF THE INVENTION

The following summary does not limit, in any manner whatsoever, the claim interpretation. Rather, the following summary is provided only to facilitate the Board's understanding of the subject matter of this appeal.

Various embodiments of the invention relate to a magnetic resonance imaging (MRI) coil array that generates a quasi-one-peak sensitivity profile. More specifically, the invention is defined claim-by-claim as set forth below.

Independent claim 1 recites an MRI RF coil array that comprises a first coil 12 having a null B_1 point and a quasi-one-peak sensitivity profile with only one peak (page 4, lines 15-17 and page 4, line 30 to page 5, line 2 of the specification; and Fig. 2D). The MRI coil array also comprises a second coil 14 oriented with respect to the first coil to reduce coupling (page 5, lines 3-6 of the specification).

Claim 2 depends from claim 1 and further recites that the second coil is within the first coil (page 6, lines 21-26 of the specification).

Claim 3 depends from claim 1 and further recites that the second coil overlaps the first coil (page 6, lines 21-26 of the specification).

Claim 4 depends from claim 1 and further recites that the second coil is cascaded with the first coil (page 6, lines 21-26 of the specification).

Claim 5 depends from claim 1 and further recites that the second coil is solenoidal (page

5, lines 15-17 and page 6, lines 21-26 of the specification).

Independent claim 6 recites a MRI coil array that comprises a first solenoidal coil 12 having a first section (first coil section A) and a second section (second coil section B), with the first section having more turns than the second section (page 4, lines 16-18 of the specification). The second section has a counter-rotational orientation with respect to the first section (page 5, lines 18-19), and the first coil has a quasi-one-peak sensitivity profile with only one peak (page 4, line 30 to page 5, line 2 of the specification; and Fig. 2D). The MRI coil array further comprises a second solenoidal coil 14 being oriented with respect to the first coil to reduce coupling (page 5, lines 3-6 of the specification).

Claim 7 depends from claim 6 and further recites that the second coil is oriented between the first and second sections (page 6, lines 21-26 of the specification).

Claim 8 depends from claim 6 and further recites that the second coil is oriented about the second section (page 6, lines 21-26 of the specification).

Claim 9 depends from claim 6 and further recites that the second coil is cascaded with the first coil (page 6, lines 21-26 of the specification).

Independent claim 10 recites a MRI coil array that comprises a first solenoidal coil 12 having a first section (first coil section A) and a second section (second coil section B), with the first section having more turns than the second section (page 4, lines 16-18 of the specification). The second section has a counter-rotational orientation with respect to the first section (page 5, lines 18-19). The MRI coil array further comprises a second solenoidal coil 14 oriented with respect to the first coil to reduce coupling and wherein the second coil is oriented about the

second section (page 5, lines 3-6 and page 6, lines 21-26 of the specification).

Independent claim 11 recites a MRI coil array that comprises a first solenoidal coil 12 having a first section (first coil section A) and a second section (second coil section B), with the first section having more turns than the second section (page 4, lines 16-18 of the specification). The second section has a counter-rotational orientation with respect to the first section (page 5, lines 18-18). The MRI coil array further comprises a second solenoidal coil 14, with the second coil being oriented with respect to the first coil to reduce coupling (page 5, lines 3-6 of the specification). The second coil is cascaded with the first coil (page 6, lines 21-26 of the specification).

Claim 12 depends from claim 6 and further recites an orthogonal coil forming a quadrature pair with each of the solenoidal coils (page 7, lines 28-30 of the specification).

Claim 13 depends from claim 1 and further recites that the second coil is placed near the null B_1 point (page 5, lines 3-4 of the specification).

Claim 14 depends from claim 1 and further recites that the first coil comprises a plurality of winding sections with the B_1 field produced by one winding section stronger than the B_1 field produced by another winding section (page 5, lines 18-22 of the specification).

Claim 15 depends from claim 1 and further recites that the first coil comprises a plurality of winding sections, with the number of the winding sections based on sensitivity parameters (page 5, lines 10-12 of the specification).

Claim 16 depends from claim 1 and further recites that the first coil comprises a plurality

of winding sections and at least one of (i) a separation between the winding sections and (ii) a diameter of the winding sections is based on sensitivity parameters (page 5, lines 23-27 of the specification).

Claim 17 depends from claim 1 and further recites that the second coil is positioned relative to the first coil based on B_1 field strength (page 5, lines 9-12 and page 6, lines 7-18 of the specification).

Independent claim 18 recites a method for providing a MRI coil array that comprises configuring a first coil 12 having a null B_1 point and a quasi-one-peak sensitivity profile with only one peak (page 4, lines 15-17 and page 4, line 30 to page 5, line 2 of the specification; and Fig. 2D). The method further recites configuring a second coil oriented with respect to the first coil to reduce coupling (page 5, lines 3-6 of the specification).

Claim 19 depends from claim 18 and further recites that the second coil overlaps the first coil (page 6, lines 21-26 of the specification).

Claim 20 depends from claim 18 and further recites that the second coil is cascaded with the first coil (page 6, lines 21-26 of the specification).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Su et al. (U.S. Patent 6,493,572) (hereinafter "Su").

VII. ARGUMENT

Applicants respectfully submit that each pending claim in the pending application is patentable over the cited art. Accordingly, Applicants respectfully traverse the rejection of the pending claims, and requests that the rejection be withdrawn and that the pending claims be allowed. In support of these requests, a discussion regarding the patentability of the claimed recitations is set forth below.

Claims 1-20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Su. This rejection was made in the Office Action dated March 28, 2006, maintaining the rejection of all claims previously made in the final Office Action dated July 27, 2005 and relying on the same Su reference.

Applicants submit that Su does not teach or suggest the recitations of independent claims 1, 6, 10, 11 and 18. Claims 1, 6 and 18 recite an MRI RF coil array that comprises a first coil having a quasi-one-peak sensitivity profile with only one peak. In the Office Action mailed March 28, 2006, the Office asserts that although Su does not explicitly teach a single peak, it "would have been obvious to one skilled in the art at the time that the invention was made that the difference between a single peak and the two peaks or multiple peaks of the prior art is a difference of degree rather than kind." (March 28 Office Action, pages 2-3). Applicants respectfully disagree.

Su et al. describes an inherently de-coupled sandwiched solenoidal array coil (SSAC) for use in receiving nuclear magnetic resonance (NMR) radio frequency (RF) signals in both horizontal and vertical-field magnetic resonance imaging (MRI) systems (see abstract of Su).

The SSAC includes a receive coil 1 consisting of two loop or solenoidal sections 1a and 1b that are spatially separated by distance W. The two loop or solenoidal sections may consist of either single or multiple conductive windings (turns) and are electrically connected by a pair of parallel conductors 1c and 1d, such that an electrical current (i) in coil 1 flows clockwise in section 1b but counterclockwise in section 1a or vice versa (column 6, lines 38-49).

Further, the SSAC includes receive coil 2, which also may be a single-turn loop or a multiple-turn solenoid, and is "sandwiched" between sections 1a and 1b of the gradient-field arrangement of coil 1 to form an RF coil array. The separated sections of coil 1 are electrically connected and positioned so that a current in coil 1 flows in opposite circumferential directions through the conductive windings in sections 1a and 1b such that magnetic fields generated from sections located at opposite sides (axial ends) of the coil achieve a null at the location of coil 2. This structural configuration provides an inherent "decoupling" of the two coils when used together as an array for receiving NMR signals (column 6, lines 50-67).

The difference between the single peak profile of the claimed invention and the two peak typical "M" shaped profile of Su is not a difference in degree as suggested in the Office Action, but is a difference in kind. The SSAC configuration disclosed in Su has an "M" shaped sensitivity profile with two peaks having a null in between as shown in Fig. 2D of Su. More particularly, the sensitivity of the first coil of Su is shown in Figure 2D illustrating the "M" shaped profile having two sensitivity maximums or peaks corresponding to the two positions of each solenoidal end section, along with a null coil sensitivity in the middle (Su, column 7, lines 52-57). Further, the peak of coil 1 of the SSAC configuration disclosed in Su must be located

between the two peaks of the "M" shaped profile to achieve the needed decoupling for proper imaging. Moving the peak would result in reduced decoupling and a degradation of the imaging of the coils resulting in an inoperable coil configuration.

The present invention does not use an SSAC configuration and accordingly provides a coil array have a sensitivity profile with only one peak. For example, the B1 field produced by one winding section of an uneven-counter-rotational (UCR) coil element may be made much stronger than the other (specification, page 5, lines 18-22). The coil configuration of the claimed invention provides a null and only one peak. There is nothing in the Su reference that describes or suggests such a one peak sensitivity profile. The reason that no such description or suggestion is present in the Su reference is because the coil arrangement of Su uses an SSAC configuration that provides a gradient B1 field that has a double peak "M" shaped sensitivity profile. Thus, the sandwiched solenoidal coil array of Su is conceptually different than the present invention and provides the "M" shaped sensitivity profile. The operation and arrangement is simply not the same. Thus, the differences between the coil arrangement of Su and the claimed invention are not merely one of degree or result, but one of operation such that an attempt to achieve the sensitivity profile of the claimed invention using the SSAC configuration of Su would result in a loss of the needed decoupling and a coil arrangement that is inoperative for imaging.

Accordingly, in contrast to Su, claims 1, 6 and 18 recite a coil of a coil array having a sensitivity profile with only one peak as illustrated in Fig. 2D of the pending application and showing a null with only one peak. This sensitivity profile allows the coil arrays shown in Figs. 4-6 of the pending application to function properly and effectively, which is different than the SSAC configuration of Su. Thus, the Office has not supported a prima facie rejection of

obviousness and neither the foregoing discussion of Su, nor any other written text or graphical illustrations within Su, renders claims 1, 6 or 18 obvious.

Claims 2-5, 7-9, 12-17 and 19-20 depend from claims 1, 6 and 18 and are likewise patentable over Su based at least on their dependency from claims 1, 6 and 18.

For reasons set forth above, it is respectfully submitted that the Su patent does not teach or suggest the claim recitations of claims 1, 6 and 18, and therefore does not render these claims unpatentable.

Claims 10 and 11 recite an MRI coil comprising "a first solenoidal coil having a first section and a second section, said first section having more turns than said second section and said second section having a counter-rotational orientation with respect to said first section" and "a second solenoidal coil, said second coil being oriented with respect to said first coil to reduce coupling, wherein said second coil is oriented" either about said second section or cascaded with said first coil.

Applicants submit that Su fails to describe the coil arrangement as recited in these claims. Su does not teach or suggest a second coil oriented about a second section or cascaded with a first coil. The Office Action merely makes a broad assertion that the several orientations of coils are presented, including overlapping and cascading configurations and that the alternative coil configurations are well known functional equivalents (Office Action, page 3). The Office Action fails to specifically set forth where Su discloses these recitations or where such teachings are well known. Therefore, the grounds of rejection have not been clearly developed, are improper, and the rejection is inappropriate. M.P.E.P. § 706.07. Such a rejection requires that

every recited claim element be present in the reference relied on or described in the known art. Applicant respectfully submits that the rejection as written merely recites a general statement without sufficiently identifying corresponding structure in the cited reference or known teachings.

Accordingly, Applicants respectfully request that the rejection of all pending claims be withdrawn, and the pending claims allowed. A favorable action is respectfully requested.

Respectfully submitted,

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VIII. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

1. A MRI RF coil array, said array comprising:

a first coil having a null B_1 point and a quasi-one-peak sensitivity profile with only one peak; and

a second coil oriented with respect to said first coil to reduce coupling.

2. A MRI RF coil array according to claim 1, wherein said second coil is within said first coil.

3. A MRI coil array according to claim 1, wherein said second coil overlaps said first coil.

4. A MRI coil array according to claim 1, wherein said second coil is cascaded with said first coil.

5. A MRI coil array according to claim 1, wherein said second coil is solenoidal.

6. A MRI coil array, said array comprising:

a first solenoidal coil having a first section and a second section, said first section having more turns than said second section and said second section having a counter-rotational orientation with respect to said first section, said first coil having a quasi-one-peak sensitivity profile with only one peak; and

a second solenoidal coil, said second coil being oriented with respect to said first coil to reduce coupling.

7. A MRI coil array according to claim 6, wherein said second coil is oriented between said first and second sections.

8. A MRI coil array according to claim 6, wherein said second coil is oriented about said second section.

9. A MRI coil array according to claim 6, wherein said second coil is cascaded with said first coil.

10. A MRI coil array, said array comprising:

a first solenoidal coil having a first section and a second section, said first section having more turns than said second section and said second section having a counter-rotational orientation with respect to said first section; and

a second solenoidal coil, said second coil being oriented with respect to said first coil to reduce coupling wherein said second coil is oriented about said second section.

11. A MRI coil array, said array comprising:

a first solenoidal coil having a first section and a second section, said first section having more turns than said second section and said second section having a counter-rotational orientation with respect to said first section; and

a second solenoidal coil, said second coil being oriented with respect to said first coil to reduce coupling, wherein said second coil is cascaded with said first coil.

12. A MRI coil array according to claim 6, further comprising an orthogonal coil forming a quadrature pair with each of said solenoidal coils.

13. A MRI RF coil array according to claim 1, wherein said second coil is placed near the null B_1 point.

14. A MRI RF coil array according to claim 1, wherein said first coil comprises a plurality of winding sections with the B_1 field produced by one winding section stronger than the B_1 field produced by another winding section.

15. A MRI RF coil array according to claim 1, wherein said first coil comprises a plurality of winding sections, a number of the winding sections based on sensitivity parameters.

16. A MRI RF coil array according to claim 1, wherein said first coil comprises a plurality of winding sections and at least one of (i) a separation between winding sections and (ii) a diameter of the winding sections is based on sensitivity parameters.

17. A MRI RF coil array according to claim 1, wherein said second coil is positioned relative to said first coil based on B_1 field strength.

18. A method for providing a MRI coil array, said method comprising:

configuring a first coil having a null B_1 point and a quasi-one-peak sensitivity profile with only one peak; and

configuring a second coil oriented with respect to said first coil to reduce coupling.

19. A method according to claim 18, wherein said second coil overlaps said first coil.

20. A method according to claim 18, wherein said second coil is cascaded with said first coil.